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MACTEC ENVIRONMENTAL RESTORATION SERVICES, LLC

Spectral Gamma-Ray Borehole
Log Data Report

Log Event A

Borehole # E33-41

Borehole Information

Farm : BX	**Tank :**	**Site Number :** 299-E33-41
N-Coord : 45,573	**W-Coord :** 53,091	**TOC Elevation :** 654.95
Water Level, ft : 252.40	**Date Drilled :** 4/1991	

Casing Record

Type : Steel-welded	Thickness, in. :	ID, in. : 13
Top Depth, ft. : 0	Bottom Depth, ft. : 20	
Type : Steel-welded	Thickness, in. :	ID, in. : 11
Top Depth, ft. : 0	Bottom Depth, ft. : 159	
Type : Steel-welded	Thickness, in. :	ID, in. : 9
Top Depth, ft. : 159	Bottom Depth, ft. : 241	

Cement Bottom, ft. : 263 **Cement Top, ft. :** 262

Borehole Notes:

This borehole was started on January 31, 1991 and was completed at a depth of 263 ft on March 28, 1991. Four separate casings were used to drill the borehole, not including the final completion casing. The first 20 ft of the borehole was drilled with 12-in. casing. The next 158.7 ft was drilled with 10-in. casing, and 8-in. casing was driven from this depth to 240.7 ft. A 6-in.-diameter casing was installed from a depth of 240.7 ft to the completion depth (263 ft). The borehole was completed with a 4-in. stainless steel casing with a screen. A 6-in. stainless steel casing extends from the surface casing lip to 0.5 ft below the ground surface; a 4-in. stainless steel casing extends from 0.5 ft below the surface to 244.9 ft; a 4-in. stainless steel screen extends from 244.9 to 262 ft. The bottom of the screen rests on fill.

The above mentioned casing sizes are erroneously quoted in the borehole construction diagram as 13 in, 11 in, 9 in and 7 in. The casing sizes routinely used at Hanford have been substituted for the sizez shown on the construction diagram. .

The annulus between the 4-in. casing and the borehole wall drilled with the 13-in. casing was filled with cement grout. The next 243 ft of the annulus was sealed with bentonite. A bentonite slurry seal was placed from 172.6 to 239.9 ft. A silica sand pack was installed from 243 to 262 ft. Fill was placed in the remaining interval. Available records do not state that the casings were withdrawn as the grout was installed; however, it would be necessary to withdraw at least the 7-in. casing to assure communication between the screened portion of the borehole and the soil.

The borehole was collared in a 4 ft by 4 ft concrete pad; the pad extends 2.5 ft into the borehole annulus. The surface casing extends 3.42 ft above the ground surface. The lip of the casing (elevation 654.95 ft) is the depth reference point. The elevation of the ground surface is 651.53 ft.

Water was encountered 252.4 ft below the reference point. The depth to the water table is 249.6 ft below the ground surface.

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Anomalous radiometric activity was noted in grab samples using a hand-held scintillometer. Elevated activity was noted in a gravelly sand unit from 73 to 80 ft. Activity of 4,000 dpm was observed in the sample from 78 ft. Similar anomalous gamma-ray activity was also reported within a silt lens at 137 ft and within sand at 160 ft. Very high gamma-ray activity (25,000 dpm) was reported from clayey silt samples selected intermittently between depths of 218 and 242 ft.

The borehole was collared in gravelly sand. This unit persisted to 95 ft, where sand was encountered. The drill returned sand to 165 ft, where gravelly sand and silt was again encountered. Clay-like silt is reported between depths of 218 and 242 ft. The borehole was bottomed in basalt (263 ft).

A borehole television survey was conducted in June 1991. A 0.50-in. to 0.75-in. bulge in the casing wall was identified at a depth of 241.46 ft. Clear water was encountered at a depth of 250.66 ft. The measured depth of the borehole by this survey was 264.4 ft. The discrepancy in depths is probably attributable to attempts to reference the survey to the ground surface, rather than the top of the surface casing.

Equipment Information

Logging System :	RLS	**Detector Type :**	HPGe	**Detector Efficiency:**	18.0 %
Calibration Date :	n/a	**Calibration Reference :**	n/a	**Logging Procedure :**	n/a

Log Run Information

Log Run Number :	1	**Log Run Date :**	02/22/1991	**Logging Engineer:**	Cram
Start Depth, ft.:	0.0	**Counting Time, sec.:**	70	**L/R :** R	**Shield :** N
Finish Depth, ft. :	164.5	**MSA Interval, ft. :**	n/a	**Log Speed, ft/min.:**	0.5

Log Run Number :	2	**Log Run Date :**	04/01/1991	**Logging Engineer:**	Cram
Start Depth, ft.:	210.0	**Counting Time, sec.:**	70	**L/R :** R	**Shield :** N
Finish Depth, ft. :	250.0	**MSA Interval, ft. :**	n/a	**Log Speed, ft/min.:**	0.45

Analysis Information

Analyst : H.D. Mac Lean

Data Processing Reference : MAC-VZCP 1.7.9 Analysis Date : 08/28/1997

Analysis Notes :

Two segments of the borehole were logged with the Westinghouse Hanford Geophysics group RLS spectral gamma-ray logging system. The interval from the ground surface to 163 ft was logged on February 22, 1991, after completion of the 11-in. casing run. A double casing (11 in. and 13 in.) was in place in the interval from the surface to 20 ft, but the grout had not yet been installed in the annulus. The interval from 210 to 250 ft was logged on April 1, 1991, before the 4-in. completion casing and associated grouts and seals had been

continuous acquisition mode, with the downhole sensor moving at approximately 0.45 ft/m (approximate acquisition time for each 0.5-ft interval was 70 seconds).

Calibration results specific to the RLS were not available for this review of the log data; accordingly, the data were analyzed to produce a qualitative indicator of the type and abundance of gamma-ray-emitting radionuclides in the soil surrounding the borehole.

Some spectra from the latter portion of the first logging run (between ground surface and 163 ft) were not usable because the measured counts were too low. Each spectrum was examined separately and only those spectra with reasonable counting times and total counts were used in constructing the radiometric logs. Unfortunately, most spectra were acquired using a 50- to 60-second stack time that produced spectra with barely usable counting statistics.

Energy calibration spectra were acquired from a field verification source before and after the logging runs. The energy and peak shape calibration from the verification spectra that most closely matched the logging spectra were used to establish the channel-to-energy parameters used in processing the spectra acquired during the logging runs. The logging system drifted during data acquisition and it was necessary to recalibrate frequently to maintain proper peak identification. Because a calibration standard was not available, a standard default calibration was used. Accordingly, the calculated radioassays are relative and do not reflect actual concentrations of radionuclides.

Because of the lack of a calibration reference, corrections could not be used for the casing(s) deemed to be present. Accordingly, the spectral gamma-ray data can be used only in a qualitative sense and only relative logs of the concentrations of identified radionuclides can be constructed. Nevertheless, it should be noted that the measured K-40 concentrations are about one quarter the concentration that is normally measured in this area using properly calibrated instrumentation. Therefore, the measured concentrations of other radionuclides can be expected to be low by a factor of approximately four (i.e., the measured concentrations are only about one quarter the actual concentration).

Radioelements from processed uranium (U-238 and U-235) and from naturally occurring K-40 were recognized. The gamma-ray peak with energy of 1001 to 1004 keV is presumed to emanate from processed U-238; the gamma-ray energy at approximately 186 keV is presumed to emanate from U-235. None of the higher yield gamma rays associated with Eu-154 (1274 keV, 723 keV, and 123.1 keV) were present, and the gamma-ray peaks from Bi-214 that are normally associated with naturally occurring U-238 were below the detection limit.

Anomalous total count-rate gamma-ray activity occurs in the absence of identified radionuclides, possibly indicating a beta emitter such as Sr-90 was present at 73 and 124 ft. The total count rate in the interval from 210 to 241 ft is abnormally attenuated because of the double casing in this interval.

Log Plot Notes:

Separate log plots show the man-made radionuclides (e.g., Cs-137) and processed uranium (U-238 and U-235) as well as the naturally occurring K-40 radionuclide. The naturally occurring radionuclides of Bi-214 that indicate natural U-238 and the nuclides of Th-232 could not be detected. The K-40 logs can be used for lithology and borehole construction interpretations. The headings of the plots indicate the specific gamma rays used to calculate the concentrations.

Uncertainty bars on the plots show the statistical uncertainties for the measurements as 95-percent confidence intervals. Open circles on the plots give the minimum detection level (MDL). The MDL of a radionuclide

represents the lowest relative concentration at which positive identification of a gamma-ray peak is statistically defensible.

A combination plot includes both the man-made and natural radionuclides, in addition to the total gamma derived from the spectral data and the tank farms gross gamma log. The gross gamma plot displays the latest available digital data and no attempt has been made to adjust the depths to coincide with the RLS data.